DRAFT
California Independent System Operator Corporation
Proposed Tariff Changes adding Detail on Integrated Balancing Authority Area Modeling and Pricing

January 22, 2008

I. Proposed Tariff Provisions For Modified Integrated Balancing Authority Area Modeling and Pricing

A. Section 27.5 Provisions

27.5.3 ~~Embedded Control Areas and Adjacent Control Areas~~Integrated Balancing Authority Areas.

To the extent sufficient data is available or adequate estimates can be made for individual ~~the embedded Control Areas and adjacent Control Areas~~IBAAs, the FNM will include a full model of ~~embedded Control Areas and adjacent Control Areas~~IBAAs used for power flow calculations and congestion management in the CAISO Markets Processes. The CAISO monitors but does not enforce the network constraints for ~~embedded Control Areas or adjacent Control Areas~~IBAAs in running the CAISO Markets Processes. The CAISO models the resistive component for transmission losses on ~~embedded Control Areas and adjacent Control Areas~~IBAAs but does not allow such losses to determine LMPs. Additional detail regarding the modeling specifications for specific IBAAs is provided in the Business Practice Manuals.

Please forward, no later than January 30, 2008, all written comments to proposed tariff language to eoneill@caiso.com

27.5.3.1 Default Designation of Resources in Integrated Balancing Authority Areas

The CAISO predefines Resource Identifiers (Resource IDs) using default associations of Scheduling Points to supporting individual or aggregate System Resources that the CAISO models at major junctions within the IBAA near IBAA generation and/or load. When the CAISO is able to identify sub-regions within an IBAA that reflect groupings of resources or locations that are sources of transactions between the CAISO and the IBAA, such as a sub-region within a BAA that is responsible for its own internal balancing of resources and transactions, the CAISO will predefine individual or aggregate System Resources for the sub-regions. When modeling of an IBAA uses aggregated System Resources, import and export Schedules will be distributed within the IBAAs using predetermined distribution factors.

27.5.3.2 Resource-Specific Designations in Integrated Balancing Authority Areas

In cases where an external generation owner chooses to designate a specific resource for participation in the CAISO Markets, the external generation owner may designate the resource as either a Dynamic Resource-Specific System Resource or a Non-Dynamic Resource-Specific System Resource, in which case the designated capacity will not be included in another aggregated System Resource, and the distribution factors for the default aggregated System Resource that represents the IBAA would be adjusted to reflect the remaining generation in the IBAA. If a Resource-Specific System Resource is established, such a resource would be settled at its LMP and not the price of the aggregated System Resource that represents the remainder of the IBAA.

27.5.3.3 Non-Default Designation of Resources in Integrated Balancing Authority Areas

Pursuant to section 27.5.3.1, the CAISO will establish Resource IDs for default combinations of Scheduling Points and individual or aggregate System Resources for Schedules to or from each IBAA. The CAISO will evaluate requests from Scheduling Coordinators for other combinations of individual or aggregate System Resources and Scheduling Points, and assign the Resource ID for the SC along with appropriate distribution factors. Such requests will be evaluated based on legitimate need and CAISO may require data to be submitted by the requesting entity in order to verify the appropriateness of assignment and use of the Resource ID. When registering intertie Market Resource IDs, a Scheduling Coordinator will be required to identify the individual System Resource or aggregated System Resource for the sub-system of the IBAA that is the source or sink of the market transaction, if the CAISO has designated sub-systems within the IBAA. Resource IDs will then be required to be correctly associated with supply or demand at the designated locations (including aggregated locations, such as subsystems of an IBAA), and the CAISO will monitor compliance with the definitions of the Resource IDs.

B. CAISO TARIFF APPENDIX C

Location Marginal Price

The CAISO shall calculate the price of Energy at Generation PNodes, Scheduling Points, and Aggregated Pricing Nodes, as provided in the CAISO Tariff. LMPs can be set by Bids to sell or

purchase Energy. The CAISO establishes Trading Hub prices and LAPs as provided in Sections xx and xx. The LMPs at PNodes, including Scheduling Points, and Aggregated Pricing Nodes include separate components for the marginal cost of Energy, Marginal Cost of Congestion, and Marginal Cost of Losses. As provided in Sections 6.5.3.2.2 and 6.5.5.2.4, Day-Ahead Market LMPs are calculated and posted on a Day-Ahead basis for each hour of the Day-Ahead Market for Energy and for each Dispatch Interval for the Real-Time LMPs.

A. LMP Composition

In each hour of the Day-Ahead Market for Energy, the CAISO calculates the LMP for each PNode, which is equal to the marginal cost of Energy available at the PNode in the hour, based on the Bids of sellers and buyers selected in the Day-Ahead Market for Energy and specified in the Day-Ahead Schedule. The CAISO designates a Reference Bus, r, for calculation of the System Marginal Energy Cost (SMECr). The CAISO uses a distributed Reference Bus to define an aggregate value of Energy for the CAISO Control Area. For each bus other than the Reference Bus, the Transmission Provider determines separate components of the LMP for the marginal cost of Energy, Marginal Cost of Congestion, and Marginal Cost of Losses relative to the Reference Bus, consistent with the following equation:

$LMP_i = SMEC_r + MCC_i + MCL_i$

$LMP_r = SMEC_r$

where:

- $SMEC_r$ is the LMP component representing the marginal cost of Energy (also referred to as λ) at the Reference Bus, r (System Marginal Energy Cost).

- MCC_i is the LMP component representing the Marginal Cost of Congestion (also referred to as ρ) at bus *i* relative to the Reference Bus.
- MCL_i is the LMP component representing the Marginal Cost of Losses (also referred to as γ) at bus *i* relative to the Reference Bus.

B. The System Marginal Energy Cost Component of LMP

The SMEC shall be the same for each location throughout the system. SMEC is the sensitivity of the power balance constraint at the optimal solution. The power balance constraint ensures that the physical law of conservation of Energy (the sum of Generation and imports equals the sum of Demand, including exports and Transmission Losses) is accounted for in the network solution. For the designated reference location the CAISO will utilize a distributed Reference Bus for which constituent PNodes are weighted in pre-specified proportions, referred to as Reference Bus distribution factors. The distribution factors are based on actual Demand at each PNode that represents Load. Once the Reference Bus is selected, and Demand has dictated the distribution factors, the cost of economically providing the next increment of Energy, based on submitted Bids, at that Reference Bus becomes the System Marginal Energy Cost.

C. Marginal Congestion Component Calculation

The CAISO calculates the Marginal Costs of Congestion at each bus as a component of the bus-level LMP. The Marginal Cost of Congestion (MCC*i*) component of the LMP at bus *i* is calculated using the equation:

$$MCCi = -\left(\sum_{k=1}^{k} PTDFik * FSPk\right)$$

where:

- *K* is the number of thermal or interface transmission constraints.
- PTDF*ik* is the Power Transfer Distribution Factor for the generator at bus *i* on interface *k* which limits flows across that constraint when an increment of power is injected at bus *i* and an equivalent amount of power is withdrawn at the Reference Bus. The industry convention is to ignore the effect of losses in the determination of PTDFs.
- FSP*k* is the constraint Shadow Price on interface *k* and is equivalent to the reduction in system cost expressed in $/MWh that results from an increase of 1MW of the capacity on interface *k*.

The Shadow Price at a given binding constraint is the value per MW of the next increment of generation that would flow across the constrained path by relaxing the binding constraint. The PTDF of a PNode with respect to a transmission path (and direction on the path) measures the change in the power flow through the path (positive or negative, with respect to the designated direction on the path) as a result of an incremental injection at the Node, balanced by incremental change of Load at the Reference Bus.

D. Marginal Losses Component Calculation

The CAISO calculates the Marginal Cost of Losses (MCL*i*) at each bus *i* as described in Section 27.1.1.2. The MCL component of the LMP at any bus *i* within the CAISO's Control Area is calculated using the equation:

$$MCL_i = MLF_i * SMEC_r$$

Where:

- MLFi is the marginal loss factor for PNode *i* to the system Reference Bus, based on an AC power flow solution. The marginal loss factor at a PNode is the incremental change in the quantity (MW) of transmission losses in the network resulting when serving an increment of Load at the PNode from the Reference Bus.
    - MLF*i* is equal to 1 - ∂L/∂G*i*, where: L is system losses, G*i* is "generation injection" at PNode *i*, ∂L/∂G*i* is the partial derivative of system losses with respect to generation injection at bus *i*, that is, the incremental change in system losses associated with an incremental change in the generation injections at bus *i* holding constant other injection and withdrawals at all buses other than the Reference Bus and bus *i*.
- SMEC*r* is the SMEC at the Reference Bus, *r*.

E. Trading Hub Price Calculation

The CAISO calculates Existing Zone Generation Trading Hub prices, as provided in Section 27.3, based on the LMP calculations described in this Attachment and in Section 27.2.

$$\text{EZ Gen Trading Hub Price}j = \sum_{i=1}^{NG} WGist * LMPi$$

where:

- NG is the number of Generation buses defined in the Existing Zone Generation Trading Hub *j*.
- WG*ist* is the generation-weighting factor for bus *i* for season *s* for time period *t* representing peak or off-peak period in Existing Zone Generation Trading Hub *j*. The sum

of the weighting factors must add up to 1. These weights are based on the previous years actual generation output as described in Section 27.3.

F. Load Zone Price Calculation

The CAISO calculates LAP prices based on the LMPs for a set of buses that comprise the LAP. These LAP prices represent the weighted average of the LMPs at the set of buses that comprise the LAP. The LAP bus weight is equal to the fractional share of each Load bus in the total Load in the LAP during the hour.

The price for LAP *j* is:

$$\text{LAP Price}j = \sum_{i=1}^{NZ} \text{WZ}i * \text{LMP}i)$$

where:

- NZ is the number of Load buses in LAP *j*.
- WZ*i* is the load-weighting factor for bus *i* in LAP *j*. The sum of the weighting factors must equal 1 (i.e., 100 percent). These weights are based on State Estimator results for similar day.

Each LAP one includes only the buses of Market Participants who are in the LAP and who have Load that is represented by that LAP's definition. Market Participants that have metered Load must either be settled at a Default LAP or a Custom LAP created for each Load point of the Market Participant (nodal Settlement).

G. Scheduling Point Price Calculation

The CAISO calculates LMPs for Scheduling Points, which are PNodes or an aggregation of PNodes that exist external to the CAISO Balancing Authority Area through the same process that is used to calculate LMPs within the CAISO Balancing Authority Area. A Scheduling Point typically is physically located at an "outside" boundary of the CAISO Controlled Grid (e.g., at the point of interconnection between a Balancing Authority~~Control~~ Area utility and the CAISO Controlled Grid). CAISO Controlled Grid that is external to the CAISO Balancing Authority Area connects some Scheduling Points to the CAISO Balancing Authority Area, and in these cases the Scheduling Points are within external Balancing Authority~~Control~~ Areas. In both of these cases, the CAISO places injections and withdrawals at the Scheduling Points, which represent Bids and Schedules whose physical location is unknown, and the LMPs for Settlement of Interchange schedules are established by the Scheduling Point PNodes.

G.1 Scheduling Point Price Calculation for IBAAs

The CAISO's FNM includes a full model of ~~Embedded Control Areas and Adjacent Control Areas~~IBAAs. The CAISO ~~may~~ places injections and withdrawals within the ~~Embedded Control Areas and Adjacent Control Areas~~IBAAs, which represent Bids and Schedules for the ~~Embedded Control Areas' and Adjacent Control Areas~~IBAAs impact on transmission flows, to ensure the accuracy of power flow calculations and Congestion Management within the CAISO Balancing Authority Area. The CAISO models the Congestion and losses in ~~Embedded Control Areas and Adjacent Control Areas~~IBAAs as described in Section 27.5.3. The CAISO will establish PNodes for the ~~Embedded Control Areas' and Adjacent Control Areas'~~IBAAs Scheduling Points through both consultation with the ~~Embedded Control Areas and Adjacent Control Areas~~IBAAs and examination of their systems. LMPs for such Scheduling Points may be

based on multiple aggregated/hub prices if it is determined that subsystems operate within the affected IBAA. The CAISO will use Intertie scheduling Constraints to limit the quantity of scheduled Energy and AS on a specified Intertie. An Intertie Constraint is a scheduled quantity limit reflecting contract scheduling capacity, as opposed to a flow based limit reflecting network capacity that is based only on Energy. In the case where the IBAA represents a single Balancing Authority, a single aggregate IBAA price is used based on the weighted average price of the nodes where System Resources have been modeled in the IBAA. In the case for an IBAA that represents an aggregation of individual sub-systems that operate with their own balancing responsibility, the prices for each operationally relevant sub-system (aggregate price) are established, based on the weighted average price using the distribution factors of the System Resources that are used to distribute transactions from the sub-system within the IBAA. The CAISO will not enforce transmission constraints internal to the IBAA and will exclude the marginal transmission losses within the IBAA from affecting the prices within the IBAA and the CAISO.

C. Tariff Definitions of Embedded And Adjacent Control Areas

~~**Adjacent Control Area (ACA)**~~	~~A Control Area that is tightly interconnected with the CAISO Control Area, but also has direct interconnections with other Control Areas, possibly including other ACAs, such that power flows in one Control Area significantly affect power flows in the other Control Area.~~

~~**Embedded Control Area (ECA)**~~	~~A Control Area that has direct interconnections exclusively with the CAISO Control Area, and no other Control Area.~~
Integrated Balancing Authority Area (IBAA)	A Balancing Authority Area that has one or more direct interconnections with the CAISO Balancing Authority Area, such that power flows in the IBAA significantly affect power flows in the CAISO Balancing Authority Area, and that is therefore modeled in detail in the CAISO's Full Network Model.